Electrical Circuits (2)

Sheet 1 - Natural Response of an RL Circuit

1) In the circuit in Fig 1: the voltage and current expressions are

$v = 160e^{-10t}V\ , t \geq 0^{+}$, $i = 6.4e^{-10t}A\ , t \geq 0$

Find:

a) R.

b) T (in milliseconds).

c) L.

d) The initial energy stored in the inductor.

e) The time (in milliseconds) it takes to dissipate 60% of the initial stored energy.

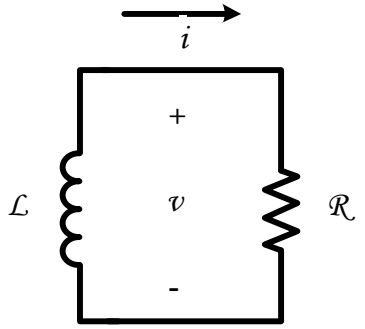

Fig .1

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2) The switch in the circuit in Fig. 2 has been closed for a long time before opening at t = 0.

a) Find $i_1(0^-)$ and $i_2(0^-)$

b) Find $i_1(0^+)$ and $i_2(0^+)$

c) Find $i_1(t)$ for t ≥ 0.

d) Find $i_2(t)$ for t≥ 0^+.

e) Explain why $i_2(0^-) \neq i_2(0^+)$

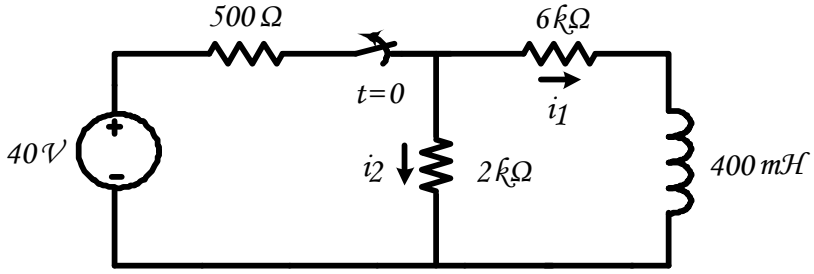

Fig .2

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3) The switch shown in Fig. 3 has been open a long time before closing at t = 0.

a) Find $i_0(0^-)$.

b) Find $i_l(0^-)$.

c) Find $i_0(0^+)$.

d) Find$i_l(0^+)$.

e) Find$i_0(\infty)$.

f) Find $i_l(\infty)$.

g) Write the expression for $i_l(t)$for t ≥ 0.

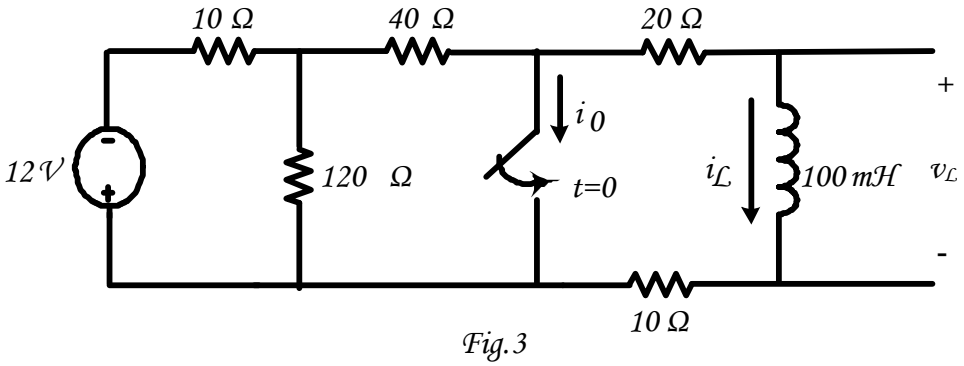

Fig. 3

h) Find $v_l(0^-)$. i) Find $v_l(0^+)$. j) Find$v_l(\infty)$.

k) Write the expression for $v_l(t)$ for t≥ 0^+ .

l) Write the expression for $i_0(t)$ for t≥ 0^+.

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4) In the circuit shown in Fig. 4, the switch makes contact with position b just before breaking contact with position a. As already mentioned, this is known as a make-before-break switch and is designed so that the switch does not interrupt the current in an inductive circuit. The interval of time between "making" and "breaking" is assumed to be negligible. The switch has been in the a position for a long time. At t = 0 the switch is thrown from position a to position b.

a) Determine the initial current in the inductor.

b) Determine the time constant of the circuit for t > 0.

c) Find i, v_1 and v_2 for t ≥ 0.

d) What percentage of the initial energy stored in the inductor is dissipated in the 72 Ω resistor 15 ms after the switch is thrown from position a to position b?

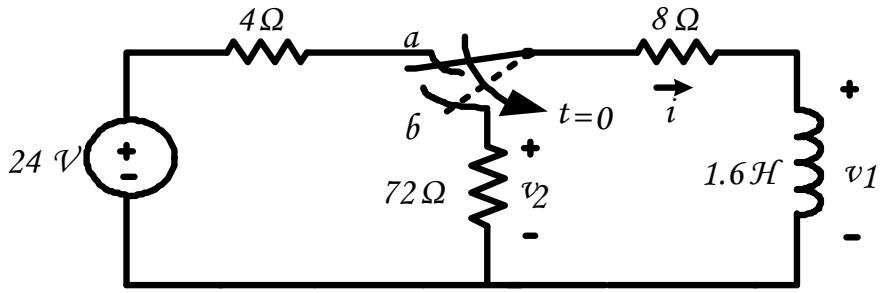

Fig . 4

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5) In the circuit in Fig. 5, the switch has been closed for a long time before opening at t = 0.

a) Find the value of L so that $v_0(t)$equals 0.5 $v_0(0^+)$when t = 1 ms.

b) Find the percentage of the stored energy that has been dissipated in the 10 Ω resistor when t = 1 ms.

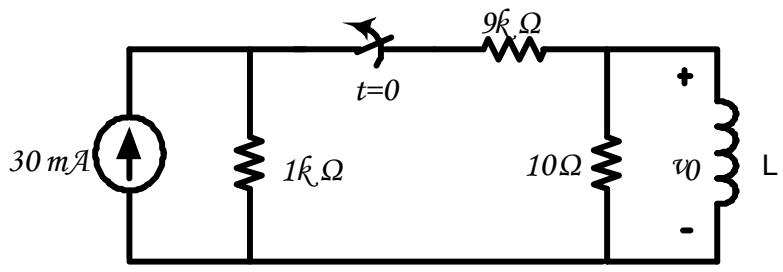

Fig.5